

SCIENCE.

FRIDAY, DECEMBER 17, 1886.

COMMENT AND CRITICISM.

IN A PAPER presented to the American philosophical society, Dr. Brinton of the University of Pennsylvania has developed some considerations concerning a form of writing intermediate between the iconographic and the alphabetic. This intermediate form of writing Dr. Brinton calls ikonomic, since that to which the figure or picture refers is not the object represented, but the name of that object. In this ikonomic writing, which Dr. Brinton finds in the Mexican and probably in the Maya hieroglyphics, he sees the explanation of the process by which the great advance was made from thought-writing to sound-writing. Thought-writing, we are told, is the oldest and simplest form, and is subdivided into iconographic and symbolic. In iconographic writing the object thought of is represented by a more or less skilfully drawn picture, while in symbolic writing a single characteristic serves to represent the object; as, for example, the track of an animal is represented instead of the animal itself.

Of course, the gap between this thought-writing and sound-writing is enormous, and endeavors have been made to explain how it was bridged by a study of the Egyptian and Chinese alphabets, each of which began as simple picture-writing, and developed into almost complete phoneticism. Dr. Brinton calls in ikonomic writing to explain the transition. In this form of communication the picture or sign does not refer to a sound as the name of the object in question, but to the sound of the name of some other object or idea. The plan is that pursued by the constructors of rebuses, who, to use Dr. Brinton's illustration, can represent the infinitive 'to hide' by the figure 2 and a skin or hide. Of this system, Dr. Brinton finds several sets of instances, and says that there is little doubt that all the Egyptian syllabic and alphabetic writing was derived from this early phase of which the governing principle was that of the rebus. He finds evidence of this in mediæval heraldry also.

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One of the earliest stimuli to the development of phonetic writing was, Dr. Brinton thinks, the wish to record proper names, which, when we rise above the savage state, are not usually significant; and therefore, if recorded at all, they must be recorded phonetically. The Mexicans added to their ikonomic system a feature peculiar to themselves in assigning a phonetic value to colors. The Egyptian sign-writing is also polychromatic, but the polychromes seem not to have had any phonetic value. So in heraldry, while colors have definite significations, these are seldom phonetic. But the Mexican writing offers many instances where the color of the object as pictured is an essential phonetic element of the sound which is intended to be conveyed. The Aztecs developed the ikonomic system beyond proper names, and composed in it words, sentences, and treatises on various subjects. Outside of these races, Dr. Brinton finds evidence of but very slight progress toward a phonetic system made by natives of the American continent.

'BOVINE TUBERCULOSIS' was the subject of a paper read by Dr. Blaine of Willard asylum, Ovid, N.Y., before the New York academy of medicine recently. In the paper and the remarks upon the same by Dr. Edson, of the New York health department, attention was called to the prevalence of consumption in cattle, and to the danger of human beings contracting the disease through the milk and meat of infected animals. As we have already repeatedly pointed out, there is but one way to prevent the sale and use of such meat and milk, and that is by a rigid inspection of the cows at the stables where they are kept, and of the carcasses at the slaughter-houses before the viscera are removed. Tuberculous milk cannot be distinguished from that which is non-tuberculous, and the most thorough expert examination of the meat of a tuberculous animal will not suffice to exclude such meat from the market unless the inspector can also examine the lungs and other internal organs in which the disease manifests itself. The cow-stable being situated, for the most part, in the country, the inspection of these should be performed by officers of the State board of health; while the slaughter-houses, being in the

cities, should be rigidly watched by experienced veterinarians, who should be on duty continuously at these slaughter-houses, in order that no single animal can be sold for meat until it has been examined. A long experience in this matter has satisfied the writer that no confidence can be safely put in the slaughterers as a class. They will, without any compunction whatever, kill and sell the most diseased animals, and do not hesitate to put upon the market even the flesh of new-born calves, and of those that have died from disease. It will be an expensive matter, it is true, to station a competent veterinary surgeon at each of the slaughter-houses in these great cities; but the interests of the public health demand it, and they should be kept there continuously. The work will then not be done as efficiently as if public *abattoirs* were established on the river-front, and the slaughter-houses now scattered throughout the cities abandoned.

IT IS WELL KNOWN that the senses are subject to normal deceptions (*sinnes täuschungen*), which seem to be inborn in the structure of the nervous system and the sense-organs. In some respects the world that we piece together from our judgments and sensations proves to be somewhat different from the world to which we apply the foot-rule and plumb-line, which we weigh and measure by objective standards. The science whose business it is to discover the nature of these discrepancies is psychophysics. M. Sorel, in a recent article (*Revue philosophique*, October, 1886), calls attention to the wide practical bearing of this study, shows how it was taken into account by the Greek architects, and how it modifies our aesthetic conceptions. He looks forward to the time when all these deceptions will be quantitatively determined, and applied in every-day life. Not only will we have a real psychophysical law (or laws), but perhaps also the signs of practical consulting psychophysicists will grace our streets.

THE MEETING OF THE NATIONAL PRISON association at Atlanta this year seems to have been very successful. The opening addresses by ex-President Hayes and Mr. Henry W. Grady of the *Atlanta constitution* were very well received, the latter especially calling forth strong expressions of approval. The various discussions on prison architecture, prison diet, the prison physician, the paroling of prisoners, reformatories, and prison

labor, were ably introduced and well conducted. The debate on prison labor seems to have excited most interest. Warden McClaughry of Joliet had the courage to defend the contract system, and regretted the action of the people of Illinois in adopting at the last election a constitutional amendment prohibiting it. Warden Brush of Sing Sing made an eminently sensible remark when he said that discussions about forms of prison labor were of little use just now, when a cyclone is sweeping over the country, and agitators are striving to put an end to all prison labor, whatever its form. It was in this discussion that Dr. Tucker created a sensation not only by defending the lessee system as practised at the south, but by pronouncing a panegyric on it. He claimed that the lessee system is the best possible, and made a number of extremely foolish and absurd remarks about the 'psychological repulsion' between races, and in closing demanded the utmost severity of punishment compatible with the convicts' physical health. He went so far as to declare that the chain-gang is the negro's paradise.

Dr. Sims of Chattanooga, who had two days before made an argument for the abolition of the lessee system, which is reported as being very cogent, made a brief answer to Dr. Tucker, and, while granting that the lessee system in Georgia is better managed than elsewhere, repeated the conclusions reached by his previous argument. Dr. Tucker had asserted, after telling his hearers that the penal features of the lessee system are too severe for whites and not severe enough for colored persons, that the death-rate of Georgia prisoners was 8.8 in the thousand. Warden Brush called attention to the official report of the state penitentiary, which showed a death-rate of 30 per thousand; but all the answer Dr. Tucker would vouchsafe was, 'My arithmetic is right.' The truth is, that the lessee system of convict labor is barbarous and inhuman; and the wonder is, that any self-respecting man could publicly defend it, especially before such a body as the National prison association.

Mr. Wines, writing in the *International record of charities and correction*, says that the tendency of thought in the prison association becomes more apparent each year. The keynote of all the discussions is that felons who pursue crime as a vocation, or are driven to it by an irresistible natural

impulse, should be permanently incarcerated for the security of society. This implies a distinction between the incorrigible and the corrigible ; and the possibility of reformation and establishment of reformatory discipline in prisons follow as matters of course. In Mr. Wines's own language, "Life sentences for recidivists, indeterminate sentences for first offenders, the mark system, the progressive classification of prisoners, conditional liberation, improved facilities for education in prison, the reformation of our system of prison labor, — all of these are parts of the sifting process by which we seek in the end to eliminate from the community the dangerous elements in society." This is an inspiring programme, and, when the reformers convince our legislatures of its practicability, undoubtedly much will be gained. But we do not hesitate to say, that, as a rule, we find, in the opinions of prison-reformers, too much theory and too little practicality. They are on the right road, but their progress is slower than it need be, on this very account.

THE DEBT WHICH the sciences of ethnology and linguistics owe to missionary labor has never been adequately acknowledged. The latest recognition of its value, though well meant and instructive, is still imperfect. Dr. R. N. Cust's monograph, 'Language as illustrated by Bible translations' (London, *Trübner*, 1886), displays the scholarship and research which would be expected from the author. He gives a classified list of versions, arranged according to the various families of languages, from which it appears, that since the establishment of the British and foreign Bible society, in 1803, the missionaries of that society and of similar associations in Great Britain, the United States, and other Protestant countries, have translated the Bible or portions of it into no less than two hundred and ninety languages and dialects. Of these, forty-nine belong to Europe, one hundred and one to Asia, sixty to Africa, thirty-eight to America, and forty-one to Oceania. Adding the older versions (some of which have been republished under missionary revision), we have a total of three hundred and twenty-four translations in the catalogue of Dr. Cust. This, however, by no means exhausts the list. His plan excludes reference to the Roman-Catholic versions, which are numerous—if not of the whole Bible, at least of portions of it. Eliot's Indian Bible, though mentioned (not quite accurately) in

the text of the monograph, does not appear in the list. Nor is any thing said of the vast number of grammars, dictionaries, and vocabularies, or the versions of catechisms and similar works, — in many more languages than are included in his list, — which we owe to these zealous laborers, of almost every Christian denomination. In spite of these limitations, however, Dr. Cust's memoir will be a most useful manual of reference for philologists. It is to be hoped that he will supplement it, as he is probably better able to do than any one else, by an additional list, comprising these other missionary publications, which will be helpful to students. Prof. Max Müller has shown that the foundation of the science of comparative philology was laid in the great work of the Jesuit missionary Hervás, — his 'Catalogue of languages,' in six volumes, published in Spanish in the year 1800, and derived mainly from the results of missionary researches. The distinguished professor himself, and the other eminent philologists of our day, — a list which includes such names as F. Müller, Gerland, Latham, Farrar, Sayce, Hovelacque, Charencey, Whitney, Brinton, Trumbull, and many hardly less noted, — who have reared upon this basis such a noble superstructure, will be the first to admit that their work owes its extent and value chiefly to the materials supplied by the later efforts of these enlightened and indefatigable toilers.

A STRIKING PROOF of the growth of scientific studies at Harvard is given in the recent report of the Museum of comparative zoölogy. Although it is within three years that the latest addition to its building has been occupied, it has already become too crowded for the needs of the university. This addition completed the first wing of the great structure originally contemplated by Agassiz, and gave a massive building nearly three hundred feet long and five stories high, with about a hundred thousand square feet of flooring, or the equivalent of seventy rooms, thirty by forty-five feet in dimensions. The new portion, nearly a third of the whole, is entirely devoted to offices, library, and purposes of instruction ; and yet the curator, Mr. Agassiz, in his recent report to the president and fellows, reports that "the unexpected demand for instruction is in excess of our accommodation. . . . It will be absolutely essential, in order to maintain the unity of organization on which so much care and money have

been expended, to provide additional quarters for the accommodation of the increasing number of students, and the natural demands for expansion in the specialties of each department. At the present moment an additional section of the museum would barely meet our requirements." We understand that work will commence on this another season. Nor is the interest wholly confined to the students. Most of the exhibition-rooms having been thrown open to the public, the number of visitors has greatly increased, so that it has become necessary to begin the erection of a large portico-front to the main entrance on the middle of the south side, and to transfer to it the staircases, which are now wholly insufficient to accommodate the stream of visitors. At the same time it will greatly relieve the now somewhat barren façade of the building.

THE NOVEMBER IOWA WEATHER bulletin, by Dr. Gustavus Hinrichs, closes with an intimation of the character of the coming winter. "The probability is very high that the winter now begun will be a mild one in Iowa and the north-west. The very fact that the last two winters have been severe ones greatly increases the probability stated. It should, however, not be forgotten that even the mildest of Iowa winters has spells of severe weather and blizzards." We must not infer from this that Dr. Hinrichs has any intention of competing with such long-range weather prophets as Mr. Blake, editor of a self-complacent sheet called the *Future*, or others of that class. The prediction here quoted is probably based simply on the fact that the mean temperature of a region for a long term of years is essentially constant, and hence severe winters will generally be compensated by mild ones; but studies of this kind in Europe show that any rules thus based are very often broken. No one could safely order a smaller supply than usual of winter coal, or attempt to make a corner in ice, on such indications, especially as the term 'mild winter' is not considered incompatible with some spells of severe weather and blizzards. Severe winters may, on the other hand, have low mean temperatures, while they are relatively free from heavy snows, which form the chief element of severity in the mind of a railroad superintendent.

ISAAC LEA, LL.D.

DR. ISAAC LEA, the Nestor of American naturalists, died at his home in Philadelphia on the 8th

instant. Dr. Lea was born in Wilmington, Del., March 4, 1792. He was of Quaker descent, his ancestors coming from Gloucestershire, England, with William Penn on his second visit. His taste for natural history exhibited itself at an early period, and was fostered by his mother, who was fond of botany, and by his association with Vanuxem, then a youth, who was devoted to mineralogy and geology, then hardly organized as sciences. Their studies were undirected, and only in 1815 did they become members of the Academy of natural sciences, then about three years old. Lea forfeited his birthright in the Society of friends by joining a company raised for the defence of the country, in 1814, though the organization was never called into service. Though engaged in learning mercantile business, young Lea became an active member of the academy, and published a mineralogical paper in its journal in 1817. This was followed by a very long series of contributions to mineralogy and conchology, recent and fossil, which have made his name familiar to naturalists all over the world. He married, in 1821, Miss Frances A. Carey, the daughter of Mathew Carey, the well-known economist, and became a member of the publishing-house of Carey & sons, from which he retired in 1851. Mr. Lea's married life was exceptionally long and happy, lasting fifty-two years, and blessed with two sons and a daughter, who still survive.

In 1825 began those studies of the fresh-water and land shells, especially the Unios, with which Dr. Lea's name will always be associated. In 1827 he published his first paper on the genus *Unio*. In 1836 he printed his first 'synopsis' of the genus, a thin octavo of fifty-nine pages. The fourth edition of this work appeared in 1870, when it had grown to two hundred and fourteen pages quarto.

Dr. Lea was a member of most American and many foreign scientific societies. He visited Europe, and studied his favorite mollusks at all the museums, where he made the acquaintance of Féussac, Brongniart, Gay, Kiener, and other distinguished men, whose names now sound like echoes of a past epoch.

In 1833 Dr. Lea published his 'Contributions to geology,' at that time the best illustrated paleontological work which had ever appeared in the United States, the text of which was remarkable for the care and judgment evinced in its preparation. Up to 1874 he continued ever busy; and the number of new forms, recent and fossil, made known by him, amounts to nearly two thousand. His activity continued almost unabated up to some ten years ago. Not content with figuring



ISAAC LEA, LL.D.

BORN MARCH 4, 1792; DIED DEC. 8, 1886.

and describing the shells alone, he figured the embryonic forms of thirty-eight species of *Unio*, and described the soft parts of more than two hundred. He also investigated physiological questions, such as the sensitiveness of these mollusks to sunlight and the differences due to sex. His 'Observations on the genus *Unio*' form thirteen quarto volumes magnificently illustrated.

Dr. Lea presided over the Academy of natural sciences for several terms, and was president of the American association for the advancement of science in 1860, beside filling various other positions of trust and honor. His scientific activity extended over a period of nearly sixty years. He received the degree of LL.D. from Harvard college in 1852. His faculties, and his interest in research, continued unabated up to the time of his death, and even to the very last such intercourse with him as his strength permitted was felt by all who approached him as a privilege. A full bibliography of Dr. Lea's writings, illustrated by an admirable etched portrait by Ferris, appeared about a year ago as Bulletin of the U. S. national museum, No. 28, and forms a volume of nearly three hundred pages.

ENGLISH WORKERS IN PSYCHICAL RESEARCH.

As requested by you, I will give the information respecting the English society for psychical research which I have been able to gather during a recent residence abroad. Both the English and American societies have been happy in securing the active support of the most able and widely known scientists, and under their guidance psychic research is assuming a definiteness and importance which claims full recognition in the commonwealth of science. It may be interesting to your readers to know something of the personnel of the English society. It was organized with the following officers: president, Prof. Henry Sidgwick; vice-presidents, Arthur J. Balfour, M.P., Prof. W. F. Barrett, Rt. Rev. the Bishop of Carlisle, John R. Holland, M.P., Richard H. Hutton (editor of the *Spectator*), the Rev. W. Stainton Moses, the Hon. Roden Noël, Prof. Lord Rayleigh, Prof. Balfour Stewart, and Hensleigh Wedgwood.

The president, a nephew of Lord Salisbury, is widely known by his philosophical works. Both his time and his most liberal purse are given without stint to the work of the society. Mrs. Sidgwick is one of the most effective contributors to the work of the society, not only in her independent investigations, but also by her writings and her able addresses at the public meetings. She is holding her own position ably against the urgent

claims of supernaturalism on the part of the believers in mediumistic phenomena. Her brother, Lord Rayleigh, is well known to those who attended the meeting of the British association in 1884 at Montreal.

Prof. W. F. Barrett of Kings college, Dublin, first organized the movement, both in England and America, and is known personally, as well as by his scientific reputation, to many of your readers. Edmund Gurney, Esq., author of a large quarto volume on 'The power of sound,' has just completed two octavo volumes entitled 'Phantasmæ of the living,' the edition of which was burned last summer just as it was being put into the hands of the printer. The second printing is issued this month. Mr. Gurney possesses the highest abilities, and is in circumstances which enable him to devote his whole time to the work of the society. In close association with him is F. W. H. Myers, Esq., whose poems are household words with the younger generation of earnest thinkers. He is one of the able corps of government chief inspectors of public schools. A most valuable remainder of his time is devoted to the work of the society. Mr. Myers has communicated in the journals of the society, and in recent numbers¹ of the *Nineteenth century* and *Contemporary review*, some most brilliant and suggestive papers on psychology, deserving of the most careful attention of scientists. Prof. Balfour Stewart gives the weight of his counsel, and his presence in the chair at the public meetings held in the rooms of the Royal society of artists in water-colors, where are found many leaders in society, including some of the royal family, as well as scientific gentlemen.

Mr. Richard Hodgson of St. John's college, Cambridge, lately an able lecturer on the philosophy of Herbert Spencer, devotes his whole time to the work of the society. Mr. Hodgson went out to India in 1884 expressly to examine the claims of Madame Blavatski, Colonel Alcott of the Theosophical society, and of other impostors or dupes, to the possession of supernatural powers, acquired by the aid of a class of thaumaturgists in Persia called Mahatmas. Not a few earnest young men in the colleges of England and America, who had lost their faith in historical Christianity, had become fascinated by the claims of the Asiatic theosophists, especially as set forth in Mr. Sinnett's works, 'The occult world' and 'Esoteric Buddhism,' and were prepared to accept the occult philosophy, and with it the alleged miracles of theosophy. The results of Mr. Hod-

¹ See *Nineteenth century*, May and July, 1884, and November, 1886; and *Contemporary review*, February and November, 1886.

son's investigations in India were issued by the society in a large octavo volume which has made the author's reputation as a patient, skilful, accurate observer and an able writer. The book is like the work of a first-class lawyer in the investigation of a criminal case. The effacement of every claim of Madame Blavatski to supernatural powers is complete and overwhelming. No such stupendous spiritual fraud has, in our generation, deluded so many educated persons. Had the society done nothing else, this work would have amply compensated for all its labor and outlay. Mr. Hodgson is now engaged, in connection with Professor Sidgwick and Mr. Myers, in some experiments on the subject of mind-transference, or the occasional communication of mental impressions independently of ordinary perceptions, under peculiar and rare nervous conditions. A series of experiments extending over several years seems to establish this as a scientific fact, but the idea is held tentatively until a much larger induction shall prove or disprove its reality. Malcolm Guthrie, Esq., of Liverpool, gave me two evenings with a subject in private life, who, while often wrong, gave such a preponderant number of successful answers as afforded an immense probability to the theory.

The members of the American society are so overworked in their own several specialties, that they are unable to give the close, continuous attention which the science requires. I wish that the services of some one who is as able and experienced an investigator as Mr. Hodgson, or Mr. Frank Podmore, could be secured for the secretaryship of the American society.

In regard to the results of the work of the society, it is too soon to expect any final verdict in a region of facts so elusive to the grasp, and so illusory in their character. The essential important result so far is, that, for the first time in the history of science, men of the highest reputation for successful investigation have collectively set themselves seriously, patiently, and without pre-judgment of the results, to an investigation, by clear, cold, unemotional methods, of phenomena which in all the ages, and never more than now, have pressed themselves on the attention of the race. Long generations of impostors have taken advantage of these phenomena to intrude, by sacrilegious crimes, into the most holy of human susceptibilities, — the sacred love for departed friends. They have wickedly and falsely professed to speak authoritatively in the name of the dead, once dear to us in life, and to found on their imbecile, vagarious utterances¹ a system of religion. It is hard to find terms sufficiently strong to characterize truly this wilful profanation of the innermost temple of our lives.

I do not prejudge the case, in the presence of so able a court as the Society for psychical investigation, by pronouncing that all spiritualistic phenomena are frauds; but I join with the more enlightened advocates in saying that evil spirits — human in my opinion, superhuman in theirs — are misleading multitudes to a fatal deterioration of character. No individuals could possibly have so completely extinguished the claims of the Blavatski fraud as could a society, authoritative in the character of its members, and permanent in its organization; and nothing but such an organization can deal with the ever-recurring claims, believed in, it is said, by millions of our countrymen, many of them of high social and even scientific reputation.

Whether, when all that is fraudulent has been eliminated, there will be any residuum of psychical phenomena on which impostors have traded, but which are real, is of course yet an open question. But it is to be remembered that smoke indicates fire, and counterfeits presuppose actual values somewhere. I do not hope that the inquiries will recover many who have fully yielded themselves to the guidance of paid mediums; but we may reasonably expect that the results of the investigations of a body of scientists of the first rank may in the future save tens of thousands of earnest men and women who are searching with intensity of purpose for what is true, before they have yielded themselves to the domination of mediums skilled in playing upon the emotions and credulity of their subjects. In this connection it may be well to say to the Siebert commission that we are waiting anxiously for the results of their investigations, and that we hope that they will be given to us in full detail, even though they may be negative in result.

The most practically important, possibly, of the investigations of the English society, is not yet in a state in which I can speak of it, but I confidently predict for it a world-wide and permanent position in the destruction of fraudulent error.

I commend 'The phantasms of the living,'¹ just issued. In it are given, for the judgment of the scientific public, the carefully sifted narratives of phenomena claimed to have been seen by reliable witnesses. It is unworthy of true science to ridicule or repudiate these until the evidence in their favor has been carefully and judiciously weighed. Candid scientists, whether believers or unbelievers in them, will welcome whatever authentically makes against, as well as for, their preconceptions.

R. P. S.

¹ *Phantasms of the living.* By EDMUND GURNEY, F.W.H. MYERS, and FRANK PODMORE. London and New York, Trübner, 1886. 8°.

DR. WALLACE ON THE DEVELOPMENT THEORY.

DR. ALFRED RUSSELL WALLACE, the distinguished evolutionist, delivered four lectures in the lecture course of the Peabody institute in Baltimore on Nov. 30, Dec. 2, 7, and 9. His general subject was 'The development theory and protective coloring.' The first lecture was devoted to a general outline of the Darwinian movement. The lecturer began by calling attention to a circumstance which he thought was too often neglected in evolutionary discussions; namely, the notions as regards species that existed before Darwin. At that time the fixity of species was regarded as an incontrovertible fact; and the origin of them, when explained at all, was referred to independent acts of creation. It is only by contrasting present zoological notions with the ones just mentioned that the immensity of Darwin's influence will be fully appreciated. It is true that before him a few writers had been bold enough to question the validity of the theory of the fixity of species. Foremost among them were Lamarck, Chambers, the author of the 'Vestiges of creation,' and others. But what was lacking in the speculations of these writers, and the reason why they were not as widely read as Darwin, was that they failed to produce any motive power sufficient to cause the transformation of species, and were not sufficiently acquainted with the facts that would suggest such a power. This was the distinctive work of Darwin, and through this the theory bears his name.

There are three main principles derived from the facts of nature from which the Darwinian theory and its consequences follow as an inference. The first of these is the high rate of multiplication of animal life, which makes it impossible for all the offspring to be sustained, and thus creates a necessary struggle for existence among themselves and with other animal forms. The intensity of this struggle depends on the rate of multiplication of the animal in question; and, when that is great, the life-period will be short, and the number who live to maturity correspondingly small. To appreciate how severe this struggle is, it may be mentioned that if a pair of partridges, a single species of birds, live for sixteen years, and breed, as they do, about eighteen young, and all these were to live and multiply at the same rate, then at the end of the sixteen years the whole surface of the earth, land and water, would not be sufficient to give all the partridges standing-room.

The second important principle is furnished by the variability of all parts of living tissue. It is difficult to appreciate the extent of this variation. Only by accurate measurements can it be realized

that the variation within species is by no means as small or insignificant as is often supposed. The published writings of Darwin deal more with the evidences of artificial variation than of that in a state of nature. But evidences of the extreme variability of natural species are abundant. Diagrams representing the variation in the size of the chief parts of the body of specimens of several species of birds, of squirrels, and so on, were exhibited, and pictured not only the extent of this variation, but the independence of the variation in one part of that in another. Each part varies independently. It was shown, too, that while the ordinary probability curve represents the natural variation of an organ, the curve must be flat and long drawn out to express the extreme limits of variation and the comparatively slight tendency towards extreme crowding about the average form.

With these facts we pass to the third main principle, the hereditary character of these variations. The offspring of parents with similar variations will tend to preserve them: and the (though not the exclusive one, as Darwin knew) motive power which selects certain variations for preservation by hereditary transmission, and consigns the rest to oblivion, is natural selection. Those variations most in accord with the environment, best adapted to succeed in the struggle for existence, will survive as the fittest. To the objection that such favorable variations would be overshadowed by the other variations all with equal hereditary tendency, the answer was given that variation was sufficiently universal to insure the variation of many individuals in a similar direction, though in less degree, at any time. A¹ variations are lying latent in the background, ready to assert themselves when the environment gives them an opportunity. The great rapidity of this change is shown in those cases where man makes artificial selections, and causes any part of a plant, for instance, which happens to be edible by him, to exhibit the greatest variability in size, nutrition, taste, and all else.

In conclusion, the lecturer expressed the view peculiar to himself, that the human mind is excluded from this evolution from more lowly forms, and that the belief in the gradual development of man's body is in no wise inconsistent with the belief that his soul springs from a higher source, and should yield to all those aspirations which religion is intended to satisfy.

In the second lecture, Dr. Wallace confined himself to the consideration of one of the devices by which animals rendered themselves the more fit to survive. This consists in adapting themselves to their environment by imitating it. The object of such imitation is primarily to escape observa-

tion from the animals that prey upon them, and to approach their own prey unobserved. The most striking characteristic of natural scenery is its color. Accordingly we find that protective coloring is the most widely distributed mode of mimicry, though the forms of natural objects are not infrequently imitated by animals. In a general way the animals in cold climates are more liable to be white, like the ice and snow among which they live, while those of tropical habitat present the wealth of color for which southern scenery is famous. The animals of the desert are quite generally of a sandy appearance, and many marine animals of a limpid, transparent tint. To account for this general correspondence between climate and color, the direct action of sunlight has been brought in as a sufficient cause. But apart from the fact that this cause has little explanatory power, it is inconsistent with the fact that many very tamely colored species abound near the equator, and attractive color is not infrequent in northern forms of animal life. Local influences are obviously of great importance. The theory that a direct photo-chemical action takes place, is in some instances undoubtedly true. Caterpillars, in passing into the chrysalis stage, have been observed to spin a dusky red cocoon when on a brick wall, a green one when on a twig, or a white one when on a white fence-paling. In these cases the change of color has been observed to take place within the few hours of spinning the cocoon, and is probably not analogous with the usual origin of protective coloring. In such unique cases as the chameleon, when the change of color is under voluntary control, the imitation of the environment is impossible if the creature be blinded. But, apart from these exceptional cases, the only sufficient explanation of color in the animal world is, that it must be a useful trait. In what way it is useful has already been stated. It is impossible to convey in a few words the cumulative effect of the instances of imitative coloring which Dr. Wallace presented. The stripes of the tiger, resembling the strong contrasts of light and shade caused by the shadow of dry grasses under a burning sun; the remarkable list of caterpillars aping the tint of the petals, and the curl of the tendrils, of the flowers and plants on which they live; and, more wonderful still, the leaf-butterfly of India, which even has the pink circles due to fungi on the leaves, which it imitates so closely that the lecturer had to point out on the screen which were leaves and which were butterflies,—these and many more give evidence of the great rôle that color plays in nature. And the evidence was still more remarkable, because it was largely taken from a work written many years before Darwin-

ism and natural selection were much thought of.

Dr. Wallace next called attention to the facts that certain exceptions to this color-adaptation were apparent only, and that color had also other functions. The raven, for example, though living in the highest latitudes, is entirely black. But it is to be noted that there the raven is not preyed upon, and that its own prey is dead matter: hence it has no need of protection, and acquires no color-adaptation.

Again: color is sometimes assumed as a means of exciting terror in an attacking enemy. Certain harmless caterpillars have acquired the reputation of being deadly on account of such variegated appendages. Finally, Dr. Wallace pointed out the use of color as a means of recognition. The fact that a rabbit, when pursued, raises its tail, and shows its conspicuous white under surface, seems the opposite of a useful act. But by this means it is enabled to recognize its fellows, and run straight to its burrow, with the white tails of the others as a guide. And it often happens that defenceless animals, whose only defence is in flight, possess similar marks for recognizing one another.

In his third lecture, Dr. Wallace continued the discussion of color in the animal world with special reference to the facts of animal mimicry. Color is a normal feature of animal life, and it will be absent or subdued only when it is kept down by outside influences. For example: those insects that are strong, or protected by a sting, are very apt to be showy and conspicuous. They can afford to be so, because their hard shell (as in beetles) or the sting (as in bees and wasps) is a sufficient protection against attack.

A very peculiar and yet widely current mode of protection is by becoming distasteful and inedible to the attacking animal. A very large class, especially of tropical, butterflies have acquired an extremely disagreeable taste, so that birds and other insectivorous creatures soon learn to avoid them. And the remarkable point is, that such insects are almost invariably conspicuously marked (it is evidently well that they should be), and are usually slow of flight and without other protection. The direct experiment has been tried by Mr. Belt, of feeding birds with these insects, and they are invariably refused. In beetles the same phenomena occur. A great many species with a soft shell, that invites attack, are protected by their inedibility, and are usually lustrous and bright. A tame monkey refused one of these beetles at once, though greedily eating all others.

We see, then, that the acquisition of certain superficial forms and markings will be a protec-

tion to the animal acquiring them ; and, after the birds have once learned that such and such insects are inedible, any insect, whether inedible or not, that gets itself mistaken for one of the inedible species, will enjoy a similar immunity from attack. This device is current in nature, and is termed 'animal mimicry.' Dr. Wallace showed many striking examples of this, — a moth closely resembling in form and marking a powerful wasp, or a wasp imitating an inedible beetle, and a host of edible butterflies and caterpillars imitating to a nicety quite different species that are inedible. A superficial observer would readily mistake one for the other, but the entomologist finds them structurally distinct in almost every particular. In fact, a South American species brightly marked and striped is really our common white cabbage butterfly transformed for purposes of mimicry. The crucial test of all such mimicry lies in the fact that invariably the mimicking and mimicked species inhabit identically the same territory, and are frequently found together. An excellent illustration of this was given. Two different authors had written up the descriptions, the one of hard-shell, the other of soft-shell beetles of a southern climate ; and Dr. Wallace selected from one volume many cases mimicking the forms pictured in the other volume, and invariably found, on referring to the text, that the two species occupied the same area.

A curious and for a long time a very puzzling series of facts was that many inedible species imitated one another. The utility of this is not very evident, and, when the number of examples of it was small, it was regarded as accidental. The explanation has been given by the distinguished naturalist Fritz Müller. It is this : a certain number of the inedible butterflies must be sacrificed in order to teach the young birds that they are inedible. The young bird must experiment, try two or three of them, and then will reason from that sample to the whole class. Now, if two inedible species are closely alike, the bird will only have to use up two or three of both species, instead of two or three of each species, before learning that they must be let alone. And thus by clubbing together, the butterflies mutually protect one another against these experimental intruders. This is not an insignificant advantage when the number of birds is large, and, especially if the two species are unequal in the number of individuals they possess, the smaller species derives a great advantage. Examples of butterflies maimed by the bills of birds were shown.

In reptiles we find poisonous snakes imitated by harmless ones ; and in birds the phenomena of sexual coloring are especially marked. Whenever

the coloring of the two sexes differs, the female is dull, and the male bright ; and this for the reason that the female is more open to attack, especially when taking care of the young and at other times. But when the nest is built in the hollow of a tree or in other not exposed places, it is found that the male and female are equally brightly colored. So, also, in some butterflies the female alone imitates an inedible species.

The last lecture was devoted to the consideration of color in the vegetable world. Here color is not so generally related to the economy of the organism, but is much more the normal product of chemical action. The chlorophyl of vegetable green forms one of the normal characteristics of plant-life. Protective coloring is also not usual. A small plant of the African desert very closely imitates the pebbles among which it takes root. Another African plant has tubers that might pass for small stones.

Many cases of apparent plant mimicry have been shown to be the result of similar conditions of existence ; as, for example, the strong resemblances of many alpine as well as of marine plants to one another. But a few cases of true mimicry exist. There is a rare non-poisonous fungus which imitates a common poisonous fungus, and is always found along with the common species. There are instances, too, of higher plants imitating an orchis that grows in its vicinity ; but these are rare.

When we consider fruits (in the botanical sense) in detail, the phenomena of color become highly important. These colors are largely for the purpose of attracting the visits of insects and other animals ; the ulterior object being the dissemination of the seeds. The main agencies by which this is effected are mechanical ones, — the wind, and by the visits of animals. A few general facts of color are at once explained by this view. Unripe fruit is of a protective green color, and when it is disseminated by mechanical agencies along the ground, as in nuts, it takes on a dull brown color. Nuts are protected by hard shells, sometimes also by bitter or by prickly surfaces, and show very clearly that the seed within, though edible, was not meant to be eaten. Being sufficiently protected otherwise, it has not acquired the property of inedibility. On the other hand, what we popularly know as fruits are intended to be eaten : they are made attractive by a bright and juicy pulp, and the seeds are generally small and smooth, so as easily to be swallowed entire, and to pass through the body of the animal ready for fertilization. The seeds, too, may be bitter, or protected by a parchment-like covering, as in the crab-apple. We see, then, that fruits when

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ripe, and not before, offer attractive colors, generally red, so that the seeds contained in them may be swallowed by animals and then serve their normal function.

To understand the coloring of flowers, one must remember that the object is to have the pollen carried from the anther of one flower to the stigma of another, and thus to secure cross-fertilization. The well-known experiments of Darwin showed that self-fertilized flowers bear fewer and smaller seeds, and when these seeds are planted they develop into smaller, weaker plants, than those resulting from cross-fertilization. Dr. Wallace then described the familiar methods by which cross-fertilization is effected and self-fertilization avoided. The anther and the stigma ripening at different times, the mysterious self-sterility of some pollen, the bending-down of the stigma away from the anthers, and the separation of the stamens and pistils in two distinct flowers, are among the simple modes of avoiding self-fertilization. The more complex ways, such as varying the length of pistil and stamens in different flowers so that pollen from a short stamen will reach a long pistil, and vice versa; the innumerable kinds of springs and triggers and traps to retain insects and sprinkle their heads and backs with pollen, — all show the extreme harmony between the vegetable and the animal world. And if a still clearer demonstration of this is needed, we have it in the extreme specialization of some plants to particular insects. Such facts abound; and in the case of an alpine species the same flower, when growing in low regions, where bees abound, is adapted to them, and in high regions is adapted to the visits of butterflies.

Dr. Wallace then gave a brief explanation of the existence of self-fertilized plants. The object is not cross-fertilization, but a slight change in conditions. If the external conditions are rough and varied, self-fertilization is sufficient; but when the environment becomes equable and monotonous, then deterioration results, new blood is necessary, and the devices for cross-fertilization are evolved, and some may imagine that in the course of geological time, changes from the one to the other have gone on according as the desired variations could be best obtained. For example, if a self-fertilizing flower is tending to die out, it may adopt cross-fertilization; if the insects that visit it die out, it may return to self-fertilization.

In conclusion, Dr. Wallace expressed the view that insects had no aesthetic pleasure in color at all, but that this faculty was reserved for man alone, and served as a mark of his distinction.

Dr. Wallace also delivered a lecture on the 'Origin and characteristics of island life' before

the students of Johns Hopkins university. The lectures were delivered in a clear and easy manner, and possessed that indefinable attractiveness which comes from many years of original research. It was a high privilege to listen to the words of one who had independently thought out the theory that bears Darwin's name, and has been intimate for years with Darwin himself.

NOTES AND NEWS.

THE December number of the *Political science quarterly* seems to us the strongest that we have yet seen. Economics are represented by Horace White's article on 'The future of banking' and Herbert L. Osgood's 'Scientific socialism;' law, by Professor Burgess's dissertation on von Holst's account of the public law of the United States — published in the *Handbuch des öffentlichen rechts der gegenwart, in monographien*, under the editorial direction of Professor Marquardsen of Erlangen — and by Professor Goodnow's article on 'The executive and the courts;' history, by the conclusion of John E. Bowen's valuable sketch of the 'Conflict in Egypt,' while Prof. George B. Newcomb's article on 'Theories of property' is partly historical, partly legal, and partly economic. The most popular article is undoubtedly Mr. Osgood's 'Scientific socialism,' which is a pleasantly written account of the life and economic teachings of Robertus. Professor Goodnow's article is a valuable and scholarly essay in the field of administrative law, and Professor Burgess's able criticism of von Holst takes rank as the most valuable article of the number. We would call particular attention to the book-reviews, which seem to us, in point of discrimination, treatment, and literary style, the models of what attractive and valuable book reviews should be. There is no space wasted on valueless works or such as contribute nothing new in the way of thought or presentation to political science, no twisting and turning of isolated passages, and no attempt to write essays on the subjects of which the books selected for notice treat. The reviews are real reviews, straightforward scientific judgments well expressed. We would select as particularly good the notice of recent books on the railway problem by Dr. Seligman, that of Clark's 'Philosophy of wealth' by Prof. Henry C. Adams, and that of Ely's 'Labor movement in America' by Prof. Henry W. Farnam.

— Prof. Thorold Rogers has not finished investigating the early economic history of England. He has in preparation a work on the early history of the Bank of England, which will present much interesting information drawn from original sources.

— The value of American scholarship is now very generally and generously recognized abroad. The latest instance of this recognition, and a very important one, is the association of Professors Briggs and Brown of the Union theological seminary, New York City, with Canon Driver of Oxford in the editorship of a new critical Hebrew lexicon which is being prepared by the delegates of the Clarendon press.

— The article 'United States' in the new edition of the 'Encyclopaedia Britannica' will be written by Prof. J. D. Whitney.

— The fourth annual convention of the modern language association of America will be held at the Johns Hopkins university, Baltimore, on Dec. 28, 29, and 30. On the evening of the 28th an address of welcome will be given by Pres. D. C. Gilman of the Johns Hopkins university, after which will follow an address by the president of the association, Franklin Carter, president of Williams college. On the 29th the usual two sessions will take place, and in the evening a social entertainment will be tendered the convention; on the 30th, session and excursion to Washington. Papers have been reported by several of the leading modern language professors both north and south. Reduced fares on several railways have been obtained, and orders for tickets are already in the hands of the secretary, Prof. A. M. Elliott, Johns Hopkins university, Baltimore, for distribution to all those who may wish to avail themselves of these lowered rates.

LETTERS TO THE EDITOR.

* * Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.

Electrical phenomena on a mountain.

I SEND you a brief account of some electric phenomena experienced by me last summer on Lone Mountain, a peak of the Gallatin range about thirty miles south-west of Bozeman, Montana.

In company with Mr. James Walsh, my assistant, I climbed this mountain on Aug. 7, 1886, for the purpose of making it a topographic station of my work in that vicinity. It is about eleven thousand feet above sea-level, and higher than any other peak within a radius of at least twenty miles. It stands alone, being separated from the other high points of the range by low saddles. The mornings for two weeks previous had been bright and clear, but afternoon thunderstorms were of daily occurrence. The morning of Aug. 7 was clear as usual; but about noon clouds had appeared in the west, and by 2 p.m. distant rumbles of thunder were heard, and dense black cloud-masses were sweeping towards us. About this time, as I was working at my plane-table, I heard a peculiar buzzing sound coming from the instrument, very much as if a large fly or wasp was

imprisoned beneath one of the plane table sheets. Placing my hand on the table, I received quite a severe shock, and, starting back in surprise, felt another in my partly uplifted right arm. Immediately after the rocks about us began to hum and buzz in a peculiar manner, giving a sort of musical sound, and the hair of our heads, beards, and eyelashes to snap and crackle viciously. This phenomenon was felt with greater intensity in a small spot on the very tops of our heads, was accompanied by a tingling sensation, and at short intervals by slight shocks, which made us cringe involuntarily. On removing our hats, a tuft of hair stood upright over these spots. A shock was received whenever the hand came in contact with the head.

Placing the instruments in a horizontal position under cover, we descended the mountain about one hundred yards to a point perhaps fifty feet below the summit, and lay down flat. While in this situation, no unpleasant feelings were experienced, although the rocks still continued their musical hum; but the shocks and tingling sensations were immediately felt on raising any portion of our bodies to an upright position. The thunder-storm, accompanied by hail and rain, soon burst upon us, and continued for half an hour, after which the peculiar electric condition of the atmosphere passed away.

We noticed during the storm that at least eighty per cent of the lightning flashes passed between masses of clouds, and not between the clouds and earth, and that none of these flashes, as determined by the interval between sight and sound, were within a mile and a half of the peak we were on.

The summit of Lone Mountain is a loose mass of broken volcanic rock. There are no large boulders or projecting points of any kind.

M. F.

Washington, Nov. 24.

Archaeological enigmas.

Professor Mason's article under the above heading in the last number of *Science* (viii p. 528) contains a report of remarks by myself which is in some respects inaccurate, and it appears to me that the subject is of sufficient importance to command the space necessary for a correction. The formation in which the hearth was found is a shore-deposit of a lake held in the Ontario basin during the final retreat of the ice-sheet. The ice-front then extended as far south as the Adirondack Mountains, and this prevented the water from escaping by the St. Lawrence valley. The local relations indicate that the hearth was made during the accumulation of the shore-deposits, so that its antiquity is somewhat less than that of the culmination of the last general glaciation of north-eastern America. Its antiquity is also sensibly identical with that of the Niagara River; so that, whenever a satisfactory estimate has been made of the time consumed in the cutting of the Niagara gorge, the age of the hearth will have been determined in years. The estimate of seven thousand years is based upon the hypothesis that the rate of recession of the falls has been uniform throughout the period of the excavation of the gorge, — an hypothesis not yet sufficiently examined.

The phrases 'Mr. Gilbert's find' and 'the Gilbert hearth' are misleading. The hearth was discovered by Mr. Daniel Tomlinson of Gaines, N.Y., and our knowledge of it is based entirely upon his oral evidence. It was first communicated to the scientific

world by Mr. George H. Harris, in the 'Semi-centennial history of the city of Rochester.' My own contribution to the subject was purely from the geographic side.

I may add, that the formation described by Mr. Murdoch is unquestionably littoral, and not greatly elevated above the present coast. What we know of recent oscillations of coasts in arctic regions, and of the rate of formation of littoral deposits, tends to the opinion that the Point Barrow gogges have an antiquity far less than that of the other finds.

G. K. GILBERT.

Washington, D.C., Dec. 11.

Polarization of resistance coils.

On p. 208 of *Science* (viii. No. 187) Professor Mendenhall's observation is noted. With my rheostat I fail to obtain any 'reverse' current properly so called. The secondary current obtained by us is in the same sense, whichever sense is given to the primary, charging current; and the secondary current is not in the same sense in all the coils.

This rheostat is constructed with brass mountings and German-silver coils: hence I infer that the main cause, at least of secondary current, is unequal heating of the junctions of coils with mountings.

Since we obtained galvanometer deflections of equal amount, as well as in the same sense, for both senses of primary current through the rheostat, we failed to observe any polarization effect by difference. It may be that thermo-electric effects at junctions of copper conductors with brass terminals happened to mask the polarization in this case, though we could not believe it probable.

If my explanation of secondary current be correct as far it goes, would it not be well to make rheostat coils and mountings of the same material?

F. C. VAN DYCK.

New Brunswick, N.J., Dec. 8.

Height of a meteor.

I have a very accurate map of the track of the large fireball which was seen near Philadelphia about 9.48 o'clock on the evening of Nov. 4. If any one can supply another, even if only approximate, so that the height may be computed, it would greatly oblige

ISAAC SHARPLESS.

Haverford coll., Penn.

Elliott's Alaska and the Seal Islands.

I beg permission to draw attention through the columns of *Science* to a glaring instance of plagiarism in Mr. Henry W. Elliott's lately published work entitled 'Our arctic province.' In this work the greater part of the third chapter (more particularly pp. 45 to 57) is quoted, or adopted with slight verbal alteration, and without the least acknowledgment, from my report on the Queen Charlotte Islands of British Columbia, published in the 'Annual report of the geological survey of Canada for 1878-79.' This in itself is perhaps a matter of small importance, though not calculated to lead the public to place unquestioning faith in the character of other parts of Mr. Elliott's volume, to which I do not here allude. The specially reprehensible feature to which I must direct attention is that Mr. Elliott has availed himself of

the fact that a division of the Haida Indians inhabit the southern part of Prince of Wales Island (Alaska) to apply my specific observations on the Queen Charlotte Island Haidas and neighboring Ischimisians to the Indian population of the Sitka archipelago generally, including ten tribes, which he enumerates. In some cases the transfer is made simply by substituting 'Prince of Wales Island' for 'Queen Charlotte Islands' of my notes; in other instances a more elaborate procedure is adopted: but in no case that I can find in chapter iii. is any part of my description credited to the Queen Charlotte Islands, nor is the name of that well-known group so much as mentioned in the chapter. Had Mr. Elliott confined himself to generalities, it would not have been so inexcusable; but he descends to details, and, as an instance, actually adopts the measurements given in my report for a house at Virago Sound, Queen Charlotte Islands, leaving it to be understood by the context that it was met with somewhere in the Sitka archipelago, and measured by himself. I should add, that the measurements were made to the nearest inch, and that Mr. Elliott has followed six of the dimensions correctly, but misquotes two of them (p. 49).

As an example of the jaunty style which Mr. Elliott manages to impart to the original, I quote only the following, in which some evidence of originality certainly appears. Many pages occur in which the style of the original is considered satisfactory, and the incorporation made verbatim, or very nearly so.

Our arctic provinces (pp. 56-57).

"But the 'loudest' feed of these savages consists of a box, just opened, of semi-rotten salmon-roe. Many of the Siwashies have a custom of collecting the ova, putting it into wooden boxes, and then burying it below high-water mark on the earthen flats above. When decomposition has taken place to a great extent, and the mass has a most penetrating and far-reaching 'funk,' then it is ready to be eaten and made merry over. The box is usually uncovered without removing it from its buried position; the eager savages all squat around it, and eat the contents with every indication on their hard faces of keen gastronomic delight — *faugh!*!"

Report on Queen Charlotte Islands (p. 111 B).

"Both the Haidas and Ischimisians have the custom of collecting salmon roe, putting it in boxes, and burying these below high-water mark on the beach. When decomposition has taken place to some extent, and the mass has a most noisome odor, it is ready to eat, and is considered a very great luxury. Sometimes a box is uncovered without removing it from the beach, and all sitting round eat the contents."

Mr. Elliott, in his introduction, refers to the great amount of literature which has appeared on Alaska, and adds, "In contemplation of this, viewed from the author's stand-point of extended personal experience, he announces his intention to divest himself of all individuality in the following chapters, to portray in word, or by brush and pencil, the life and country of Alaska as it is, so clearly and so truthfully that the reader may draw his or her own inference, just as though he or she stood upon the ground itself." Possibly wholesale unacknowledged appropriation is Mr. Elliott's idea of 'divesting himself of all individuality.' He has certainly succeeded in divesting most of the facts contained in his third chapter of all individuality, by applying them to a region and to tribes not intended by the writer. Why should Mr. Elliott leave the extensive tours on

Alaska, and the personal experience to which he refers, to avail himself of the observations of another in a different though adjoining region? We are of course aware that a considerable similarity exists between the manners and customs of the various Indians of the north-west coast; but to transplant observations made in one specific district bodily to another is a proceeding utterly repugnant to any one with a regard for scientific precision — or truth.

GEORGE M. DAWSON.

Geological Survey of Canada,
Ottawa, Nov. 27.

The best reply to make to a criticism like Mr. Dawson's is to let a few facts bearing on the case speak for themselves. Let me take the case of complaint cited by him, — the rotten fish and roe feast. In 1865-66, twelve and thirteen years before he knew anything about the subject, I witnessed and smelled my boat's crew of Haida and Stickeen Indians open and eat rotten salmon and herring roe, and rancid fetid Aalachan fat, at a dozen different camping-places between Stickeen Mouth, Alaska, and Port Essington, B.C. My notes and drawings were made then, which appear in my recently published work. These notes and drawings were re-written and selected, and all in the hands of my publisher Feb. 26, 1886. I never saw Mr. Dawson's work, or even knew of it, until the middle of April, 1886; then my attention was called to it by Professor Mason, who has the only copy known to this establishment. He, at that time being at work on a collection just received from British Columbia, incidentally alluded to it, and, finding I had never seen it, asked me to read it.

'Our arctic province' was not written for the eye or ear of scientific specialists: were it so conceived, its covers could not be expanded wide enough to embrace the subject; and it would, if so written, be an utter failure as a popular and pleasant book to handle on the question. Hence all this detail, controversy, and citation has been justly eliminated from it.

HENRY W. ELLIOTT.

Smithsonian Institution, Dec. 10.

Star rays.

In the oldest pictures in which the sun, or stars, or burning candles, are features, these objects are represented as surrounded with rays, or points, or brushes of light; and the conventional figure of a star is to-day a pentagon, with its sides extended to an intersection so as to form five pointed projections. It is evident that this manner of representing luminous bodies is due to the fact that such appendages have their counterparts, to a greater or less degree of correspondence, upon the retina of the eye, when such bodies are viewed. But it has never been supposed by any one that such points or rays were actual emanations of luminous matter from the objects, nor the converging of their light into these forms by the atmospheric medium through which they are viewed. Such impressions have always been considered so simple and constant as not to deserve any notice on the part of scientific inquirers, as far as I have ever heard; and it is because my curiosity has been excited to know their cause, that I appeal to the readers of *Science* for more light upon the subject.

In the case of the electric light, now so common in

our streets, I have been able to account for the principal feature of their apparent radiations. The very long rays, which, if the carbon points were at the same distance as is the sun, would be many millions of miles long, I find are nothing more than the reflection of the light from my eyelashes; as is proved by the fact of their changing their position to correspond with every change I make in the position of my eyelashes, and of their total disappearance when I intercept the light by my fingers or other screen. But I cannot by any practical means thus get rid of the great body of minor rays which seem to interlace with each other, and which sparkle with the prismatic colors. The experiment with the longer ones, however, forces upon me the conclusion that these are due to some other part of my optic apparatus which is out of my reach.

I have also gazed upon the full moon, and, while doing so, have at different times, and with different conditions of the eyes, and with different positions of the eyelids, observed with great distinctness nearly every form that I have seen published, representing the solar corona as observed by the astronomers during an eclipse of the sun, and especially those rifts in the corona which extend to the very surface of the luminous orb, — features which, in the case of the sun, utterly disprove every hypothesis that has been advanced to account for the existence of the corona.

If the corona is an emanation from the general surface of the sun, or the illumination of a circumambient atmosphere of matter, how are we to account for these rifts, which imply immense long and narrow vistas, following great circles of the sphere, which constantly shift their position on its surface so as to coincide with the line of view of the observer on the earth, through all the movements of solar rotations and of the earth in its orbit?

Mr. Proctor suggests that the corona is the more highly illuminated centre of an hypothetical stratum of stellar substance, to which the orbits of the earth and other planets are confined, and which gives out the zodiacal light. If this were so, those immensely long projections should radiate from the equatorial zone of the sun. But the zone from which they project is always perpendicular to the line of view of the observer.

What quality can be assigned to a homogeneous atmosphere, either upon the moon or the earth, which is capable of perverting the light of the sun into such fantastic shapes as have been observed, and what can induce such changes in that quality to correspond to the manifold changes in the forms recorded?

Considering the complete failure of every hypothesis to account for the phenomenon, and during the pause which seems to have overtaken this inquiry, may it not be excusable for those who are ignorant to inquire whether sufficient attention has been given to the possible effects of the structure of the lenses and tubes of the telescopes through which the observations have been made, and whether it may not be possible to abolish the corona in the same way that the 'black drop' has been abolished? If reflections from my eyelashes and eyelids can produce such figures upon the retina, may not reflections from the tubes or other parts of the telescope produce them upon the photographic plate?

R.D. RANDOLPH.

Baltimore, Md., Dec. 10.

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SCIENCE.—SUPPLEMENT.

FRIDAY, DECEMBER 17, 1886.

THE PSYCHOLOGY OF SPIRITUALISM.

The history of thought, says Dr. Bastian, has a double aspect. Its main object is to record the advance steps in the progress of civilization, to trace the normal, psychological growth of racial culture, and set forth the evolution of rationality. But it is hardly less instructive to regard the shadowy side of the picture, and study the mental movements of that ever-present and vast portion of mankind who by occult and mystic proceedings attempt to short-circuit the roads to knowledge and immortality. Weird notions and strange theories find a ready home in the disordered brains of such semi-morbid fanatics; and, when once they gain hold on the popular imagination and belief, such inhuman pages of history as those that record the horrors of witchcraft, the follies of alchemists and searchers for the philosopher's stone or the fountain of eternal youth, the wide-spread misery of mental epidemics or the bestial self-tortures of crazed ascetics, must be written. These deviations from the normal lines of progress — back-slidings, as the Hebrew prophets termed them — present close analogies in the mind of the evolutionist to atavistic reverions in some ways, and to useless rudimentary organs in others. They appear as reverions to more primitive modes of thought in the light of what anthropology has told us of the psychic life of savage tribes.

Hardly a page in the story of the vagaries that have turned aside the minds of our ancestors from the straight path of knowledge but can find its parallel in the fancies built up by untutored savages to satisfy their dearest longings and quiet their most constant fears. In brief, it is in the statistics of thought that our author finds the material for the complete study of intellectual evolution, and quite as much of those modes of thought that are reverions or survivals as of those that are in the direct line of advance. Modern science has decided to accept as its logic that system of principles most conveniently described as Baconian; but this process seems slow and insipid to those who have the final goal of all revealed to their ecstatic insight, and the logic on which they stake their faith is such as can only be fully appreciated when the eyes are calmed in dimly lit chambers,

In suchen des spiritismus und einer naturwissenschaftlichen psychologie. Von A. BASTIAN. Berlin, Stricker, 1886. 12^o.

the brain flushed with excitement, and the judgment unsettled by intense expectancy.

Spiritualism, theosophic lore, occult science, and all the mysteries that follow in their train, are simply the expression which this atavistic tendency of human thought has taken in our scientific century. When introspection, meditation, revelation, or dogma were the current modes of discovering truth, the occultists, mystics, and the rest claimed them as the foundations of their creed. To-day we experiment, observe with the senses, photograph, and so on; accordingly the 'vital influence' and 'telepathic impact' has been forced to leave its record in childish scribblings; our ghosts have been weighed and smelled and photographed; yes, even the methods of scientific psychology (reaction-times) have been employed to discover the most beneficial kind of 'smell-pills' and the clothing in which our soul can most conveniently dispense itself. The Hipp chronoscope is pictured on the frontispiece of Jäger's 'Entdeckung der seele.' Every insane-asylum is a microcosm of the world without. Formerly our paranoics heard voices in the air: now they hear them through the telephone. So, too, this morbid pseudo-scientific spirit apes the manners of the true goddess, and by such disguises sues the favor of the world.

It is in some such strain as this that Dr. Bastian as an anthropologist not alone familiar with the culture-history in which we form a link, but thoroughly at home in the mind-habits of 'natural' savage tribes not uncivilized but with a peculiar civilization of their own, calls up the procession of modern spiritualists, theosophists, and their like, and sits in judgment upon them. He shows them how they are simply repeating, with new costumes and improved scenic effects, the tragic comedy of former times, and falling back upon the play-tricks of the childish savages whom they profess to despise.

It would be a vain attempt to fill out, however roughly, this sketch of Dr. Bastian's point of view. For that, the reader must (though not without misgivings on the part of the reviewer) be referred to the original. The author is no stylist. There is no attempt at any classification or subdivision; no index; a preface that reads like part of the text; no chapters, simply 216 pages of tersely written paragraphs. Add to this, constant quotations from seven or eight languages (in one passage five languages occur in four lines) and a

most puzzling and frequent use (one parenthesis to every two and a half lines) of the parenthesis, and some slight notion of the extreme Teutonic character of this valuable pamphlet will be obtained.

JOSEPH JASTROW.

THE VENOMS OF POISONOUS SERPENTS.

THE experimental work which forms the basis for this valuable contribution to science was carried on in the physiological laboratory of the University of Pennsylvania. The reputation of its authors is such as to make it a standard work of reference. It brings our knowledge of the composition and effects of the venoms of serpents up to the present time, and we surmise that many years will elapse before the results recorded will be modified to any great degree. The subject is one, which, while it is full of interest to the reader, must nevertheless have been one involving no inconsiderable danger to the experimenters. To have handled two hundred living venomous serpents, one of them eight and a half feet long, weighing nineteen pounds, and furnishing one and a half drams of venom, cannot have been a very delightful task: and those who were willing to undertake it must have been enthusiastic investigators, as indeed we know they were. The serpents upon which the experiments were performed included rattlesnakes (*Crotalus adamanteus* and *C. durissus*), moccasons (*Ancistrodon piscivorus*), ground rattlesnakes, copperheads, and coral-snakes. The venom of the cobra was obtained from India, while all efforts to obtain the poison of the Indian viper (*Daboia Russellii*) were unsuccessful. The authors started with the theory, long held by Dr. Mitchell, that snake-venoms are not simple in composition, but are composed of two or more poisonous substances, and that in the qualities and quantities of these agents would be found an explanation of the differences between serpent-venoms as to power to kill and mode of causing death. All fresh serpent-venoms are more or less alike in appearance, being fluids varying from the palest amber tint to a deep yellow. When a drop of the fresh venom of the *C. adamanteus* was examined under the microscope with a $\frac{1}{2}$ Zeiss, homog. immersion lens (amplification, 800 diameters), in addition to oval nucleated red blood-corpuscles, leucocytes, and club-shaped epithelial cells, certain colorless particles are seen, some larger and of an albuminous character, others smaller. Some of these particles resemble bacteria, but are not: they do not multiply in cultures nor stain with the aniline dyes. In ad-

Researches upon the venoms of poisonous serpents. By S. WHIR MITCHELL and E. T. REICHERT. Washington, Smithsonian Inst., 1886.

dition to these, there are, however, bacteria in fresh venom of a micrococcus form. Although careful search was made for ptomaines, none were found. An insoluble precipitate was obtained, which does not seem to have been recognized, and, when injected into pigeons, produced no toxic effect. Certain globulins were also obtained from the venom, to which the writers have affixed the names of water-venom-globulin, copper-venom-globulin, and dialysis-venom-globulin, from the method by which they were obtained. In addition to the globulins, peptones were also obtained. The differences in the proportions of the various globulins and peptones in different venoms are of immense importance in affording an explanation of the physiological peculiarities exhibited in poisoning by different species of snakes. The proportion of globulins in *Crotalus* is over three times the quantity in the *Ancistrodon*, and nearly fifteen times that in the cobra. The investigation, which has continued over a period of several years, included a study of the effects of various agents on venom, the effects of venom when applied to mucous and serous surfaces, their effects on the nervous system, and a comparison of globulins and peptones as regards their local poisonous activity. The action of venoms and their isolated globulins and peptones upon the pulse-rate, upon arterial pressure, and upon respiration, was thoroughly examined. Elaborate experiments were made with filtered venom, and with cultures for the study of the morphology of the bacteria contained in the venom. The anatomical changes produced in the animals experimented upon were carefully studied and recorded. The conclusions to which the authors arrive, as the result of their patient and laborious investigation, are, 1^o, that venoms bear in some respects strong resemblance to the saliva of other vertebrates; 2^o, that the active principles of venom are contained in its liquid parts only; 3^o, that venoms may be dried and preserved indefinitely with but little impairment of their toxicity; 4^o, that there probably exist in all venoms representatives of two classes of proteids, globulins and peptones, which constitute their toxic elements; 5^o, that potassic permanganate, ferric chloride in the form of the liquor or tincture, and tincture of iodine, seem to be the most active and promising of the generally available local antidotes. The fact that the active principles of venoms are proteids, and closely related chemically to elements normally existing in the blood, renders almost hopeless the search for a chemical antidote which can prove available after the poison has reached the circulation, since it is obvious that we cannot expect to discover any substance, which, when placed in the blood,

will destroy the deadly principles of venom without inducing a similar destruction of vital components in the circulating fluid. The outlook, then, for an antidote for venom which may be available after the absorption of the poison, lies clearly in the direction of a physiological antagonist, or, in other words, of a substance which will oppose the actions of venom upon the most vulnerable parts of the system. The activities of venoms are, however, manifested in such diverse ways, and so profoundly and rapidly, that it does not seem probable that we shall ever discover an agent which will be capable at the same time of acting efficiently in counter-acting all the terrible energies of these poisons. The monograph closes with a complete bibliography of the subject, and a number of colored lithographs, which serve to illustrate in a most perfect manner the lesions caused by the venoms.

MCLENNAN'S STUDIES IN ANCIENT HISTORY.

THE first edition of McLennan's 'Primitive marriage' was published in 1866. The novelty and striking character of the theories propounded in it, the accumulation of interesting facts, and the clear and attractive style, aroused attention, and led to much discussion. Many writers of note—Sir Henry Maine, Sir John Lubbock, Mr. L. H. Morgan, Professor Bachofen—took part in the controversy. Darwin himself entered the arena. Ten years later, to meet a pressing demand, the work was reprinted by the author, with additions, under the title of 'Studies in ancient history.' That the interest awakened in the subject has remained unabated is evident from the fact, that, since the author's lamented death, his brother has found it necessary to issue a new edition of this volume, with some notes of his own, designed to clear up doubtful points, and to indicate certain changes of view which the author had announced. The publication will be welcome to all who take an interest in the study of the primitive history of our race, and who have not had an opportunity of procuring the earlier editions. Few works on the subject can be read with greater satisfaction, even by those who do not yield assent to the author's views. The grace of diction, the profound scholarship, and the stimulating originality of thought, displayed in the work, combine to make it one of the classics of modern science.

Twenty years, however, have not sufficed to establish the views put forth with so much confi-

dence, and maintained with so much ingenious reasoning. On the contrary, antagonistic theories have sprung up on every side. To some extent, indeed, the author, as his brother intimates, had changed his views; and it is not easy to determine what were the precise conclusions at which he had arrived on some important points. The view, for example, which represents the earliest tribes of men as living in a state of 'communal marriage,' or, in other words, of promiscuous intercourse, is maintained throughout his first publication. This view was subsequently adopted by Lubbock in his 'Origin of civilization,' and by Morgan in his 'Ancient society.' But it was contested with overwhelming power of argument by Darwin, in his 'Descent of man.' He showed that the nearest congeners of man, the anthropoid apes, are all pairing animals, and, like other pairing animals, fiercely jealous. That human beings, on their first appearance, should at once have sunk in the social scale below the apes, and even below the sparrows, and should only have emerged from this condition of more than brutal debasement by a long succession of struggles and experiences, is of all suppositions the most improbable.

This consideration seems to have impressed Mr. McLennan, and to have produced a remarkable change of opinion. One of his essays, added in this volume to the original treatise, comprises a severe and destructive criticism of Sir John Lubbock's scheme, which makes 'communal marriage' the starting-point of human society. With equal force of logic, the author disposes of Morgan's 'classificatory system' and Bachofen's 'mother-right,' both of which are founded on the same fanciful basis, thus demolished by him. Yet, strangely enough, he fails to see that his own theory of 'marriage by capture' rests on the same unsafe foundation, and must fall with the others. His view, as presented in his earliest publication, and not subsequently retracted, is that in the first stage of tribal society 'utter promiscuity' prevailed; that with this was connected the practice of female infanticide, the male children being preserved to add to the strength of the tribe, while females were regarded as a source of weakness; that the scarcity of females in a tribe led to the custom of capturing them from other tribes, and this custom finally became the law of the tribe. Thus marriage arose, at first exogamous (that is, restricted to women of other tribes or kindreds), and afterwards, as society advanced, either endogamous (that is, restricted to the clan) or general, as in civilized nations. As the author himself, in his later essays, has taken away the main substructure on which his ingenious theory was built, it is not necessary to refer at any length

Studies in ancient history, comprising a reprint of Primitive marriage. New ed. By the late JOHN FERGUSON MCLENNAN. London and New York, Macmillan, 1886. 8°.

to the facts and arguments which have been brought forward in opposition to it. That among the greater number of tribes which have been found in the lowest stage of savagery, no trace of marriage by capture has been discovered; that among such tribes female infanticide is by no means a common practice; and that, on the contrary, female children are regarded by their parents as a source of wealth, through the price which they bring for wives,—these and similar facts seem to prove that the custom, of which the author has pointed out so many widely scattered traces, did not originate in any general law of social organization, but was, like polygamy, polyandry, the North American clan-system, the Australian class-system, the Hindoo caste-system, the Roman paternal autocracy, and the many other social arrangements which have been pressed into the argument, merely a casual and local custom,—one of those numberless diversities of tribal organization, which, like the diversities of language, indicate at once the variety of the human faculties and the unity of the species. The conclusion announced by Darwin, that all the races of men are descended from a common ancestry, and that all inherit the ordinary pairing instinct,—which, however perverted in occasional instances, manifests itself distinctly in the vast majority of communities, savage and civilized alike,—is one which will doubtless be generally accepted in the end. The theories which oppose this conclusion destroy one another; and the results of the profoundest science bring us back to the common belief which prevailed before the theorizers began their work. H. HALE.

STEPHENS'S HISTORY OF THE FRENCH REVOLUTION.

THE literature of the French revolution would in itself compose a library, and Mr. Morse Stephens naturally begins his preface with an excuse for adding another history to a list which includes such names as Thiers, Taine, and Carlyle. In a masterly survey of his authorities he shows, that, since Carlyle wrote, our sources of information have been materially increased; that a number of local records and personal memoirs have come to light; and he lays particular stress on a collection of pamphlets in the British museum which Carlyle found to be inaccessible. Briefly, Mr. Stephens has spent untiring labor on the subject for years past, 'to the exclusion of every thing else,' and he aims at embodying in this volume the results of specialist researches. He notes in this connection the influence of the German school of

A history of the French revolution. By H. MORSE STEPHENS. Vol. I. New York, Scribner, 1886. 12^o.

historians,—an influence, by the way, which is discernible in the increasing study of parochial and diocesan history in England, and in the rise of historical magazines and reviews such as the monthly *Révolution Française* and *Revue de la révolution*, which are entirely devoted to the history of the revolution.

Mr. Stephens introduces his work to the American public in a separate preface, in the course of which he remarks that the example of American independence was a more powerful ideal with the earlier revolutionists, the admirers of Lafayette and Franklin, while the later leaders sought inspiration from the republics of Greece and Rome. The Declaration of the rights of man he somewhat unfairly describes as a 'ridiculous fancy of the admirers of the American constitution,' foisted on the assembly by Lafayette. Surely the declaration breathes the spirit of Rousseau, and, far-fetched and extravagant as it may seem to us, it was the gospel of the French revolution.

While the conflict of king and subject was passing into the tyranny of the state, the questions raised were so varied and suggestive that the epoch forms a kaleidoscope which can always be viewed in a new aspect. Theorists had full sway, and many of those great modern movements directed against the constitution of society—movements which have lately received a new impetus—were inaugurated. Now that it is hinted that democracy does not imply liberty, and that a new school of 'physiocrats' is growing up in the stronghold of modern democracy, it will be useful to study the experiments made by land and labor reformers a century back.

The plan of Mr. Stephens's work is simple and effective. In the present volume he carries the narrative from the assembly of the notables to the dissolution of the constituent assembly, aptly introducing sketches of important departments of the subject, such as the court, the army, and the church. There is no 'Carlylese' or lurid color in his description; but if he does not write at high pressure, 'flamefully,' he tells his story in clear and straightforward English. Here and there occurs a slovenly phrase, such as, "the influence of the parlement and the affection has been noticed when discussing"—but the style generally is attractive by its simplicity and correctness. The fall of the Bastile is told unobtrusively. We notice that the celebrated speech, 'Paris has conquered her king,' is attributed to Lally Tollendal instead of to Baily, presumably on the authority of the museum pamphlets. Baily makes no mention of it in his 'Memoirs.'

Mr. Stephens is, we think, weakest in his estimate of character. Study of Mirabeau's corre-

spondence with La March seems to have prejudiced him against the 'moral' characters of the revolution, — Necker, Bailly, and Lafayette, — whom he scarcely mentions without a sneer. The removal of the king and assembly to Paris is put down to "the extreme vanity of Lafayette, who wanted them there merely to increase his own honor and glory." The starvation "gave Lafayette an opportunity to pose as savior of the monarchy." In the matter of the suspensive veto, Necker "acted vainly and foolishly on the plan which Lafayette had vainly and foolishly invented." What was criminal in Lafayette at the Hotel de Castries, it becomes a virtue in Mirabeau to defend. In short, Mr. Stephens feels something of the rancor which Mirabeau felt when "every attempt of Mirabeau to unite himself to Necker and Lafayette had been spurned by those vain and conceited men." On the other hand, the double dealing of Mirabeau when he was in the pay of the court is put down as masterly statesmanship, and his want of principle is almost made a proof of his greatness. Nothing is said of the difficulties of Lafayette's position, which exposed him to attack from both sides; of his chivalrous loyalty to the court, yet sympathy with the popular cause; or of the high opinion entertained of him by the best contemporary critics.

There is much new and interesting matter in the account of the elections to the states-general, and of the local *cahiers* of grievances. Mr. Stephens is a lover of exact detail, perhaps at times overloading his history with biographical minutiae. There are also sketches of the economic and financial state of France in connection with the views of the foremost thinkers (to whom the evils of the internal *douanes* suggested the doctrine of free trade), showing the results of the issue of a paper currency and of the wasteful system of taxation. The theory (p. 176) that the burning of châteaux was due to the desire of the copyhold tenants to get possession of their court-rolls seems a little strained to any one who has read contemporary accounts of the condition of the French peasantry. Points made very clear are the unpractical character of the constituent assembly, with its 'theory of irregular verbs,' — the reasons why it was left behind by the provinces in the march of ideas, — and the widening gulf between the *bourgeois* and lower classes, especially the *ouvriers*, who suffered from protective trade associations.

Enough has been said to show that Mr. Stephens has produced a work which promises to rank among the standard authorities on the period, and which will be of sterling historical value to the student of modern democracy.

VINES'S LECTURES ON THE PHYSIOLOGY OF PLANTS.

THERE has long been felt the need of a good text-book on vegetable physiology in the English language, and hence we heartily welcome the appearance of this excellent treatise. The investigation of the phenomena of plant-growth, nutrition, respiration, metabolism, reproduction, etc., has of recent years been almost entirely accomplished by the Germans, and the prominent part they have taken in these researches will be at once apparent to the reader of Professor Vines's work. As the title indicates, the volume is an expansion of the author's lectures on the subject, and these are twenty-three in number. Nearly ten years have elapsed since its preparation was begun, ill health and the pressure of official duties having retarded its publication.

Lecture I., as introductory, treats of the general features of the vegetable cell, its cell-wall, and its contents, *Protococcus* and yeast being used as examples with references to the tissue systems of multicellular plants. Then follow two chapters on the structure and properties of the cell, in which are discussed the growth, thickening, and lignification of the wall; its optical properties; and its incrusting mineral matters, — oxalate and carbonate of lime, and silica; the protoplasmic contents and the nucleus; the vacuole and the cell-sap. The molecular structure of organized bodies is then considered. An account is given of 'imbibition,' or capacity of organized matter for absorbing water. The rival theories of Naegeli and Strasburger are compared; and the latter appears to be favored by the author, though farther on in the book reference is made to Naegeli's *micellar* hypothesis. In this connection allusion is made to Hale's old experiment of putting peas to soak in an iron pot with a leaden cover on which was placed a weight of 184 pounds: the force generated by imbibition was sufficient to raise the cover and weight. Here we also find an instructive discussion of the osmotic properties of the cell, and it is pointed out that substances may be transferred from cell to cell by means of the connecting threads of protoplasm as well as by osmosis.

Lecture IV. is on the absorption of water by root-hairs and the epidermal cells of rootlets, and is full of important information for the agriculturist. The structure of soils, the action of acid cell-sap, which saturates the absorbing organs and brings salts insoluble in water alone into solution, are described, and numerous analyses of the ash of plants are given. The discussion of the absorp-

Lectures on the physiology of plants. By SYDNEY HOWARD VINES. Cambridge, University press, 1886. 8°.

tion of gases through stomata and lenticils is given in lecture V. It has long been known that under certain conditions some plants absorb oxygen : this is most markedly true of fungi ; and Professor Vines states (p. 76) that it appears that the power of absorbing this gas is possessed by all plants, sustaining this conclusion by the experiments of Wolkoff and Mayer on seedlings, those of De Saussure, Oudemans, and others on germinating seeds, and of De Saussure on many flowers. It also appears, that, if roots are not supplied with oxygen, the plant soon becomes unhealthy, and ultimately dies. Portions of plants which contain chlorophyl abundantly, absorb oxygen in darkness, while this is given off during their exposure to sunlight. All green portions absorb carbonic acid in sunlight. Ammonia also is taken from the atmosphere, as has been shown by Ville ; but free nitrogen is apparently not thence absorbed, the presence of this gas in the cell-sap being accounted for by its solubility in water.

Lecture VI. is on the movement of water in plants. A very clear account of this phenomenon is given, the circulation being regarded as passing mainly through the cell-walls of the lignified tissues. Transpiration, or the exhalation of watery vapor from the leaf surfaces, is treated of in the seventh lecture, and the food of plants in the eighth.

The next six chapters are devoted to the metabolism of plants, — the changes which materials undergo in the tissues under the influences of light, heat, chemical affinity, etc.; and these are perhaps the most valuable parts of the book. Here the discussion begins with the consideration of the formation of non-nitrogenous organic substances, principally starch ; then that of nitrogenous substances, collectively termed ‘amides,’ and of the function of chlorophyl, which is concisely stated to “absorb certain rays of light, and thus enables the protoplasm with which it is intimately connected to avail itself of the radiant energy of the sun’s rays for the construction of organic substance from carbonic acid and water.” A summary of what is now known of the metabolic processes is admirably stated on pp. 325–328 ; and an instructive table, showing the income and expenditure of matter and energy, is given. The energy is entirely referable to the absorption of light by the chlorophyl, and to heat.

Lecture XV. is devoted to the phenomena of growth ; and the following six chapters, to irritability, which is thus minutely described, and the forces inducing its manifestation fully discussed. In the last two chapters the subject of reproduction is treated ; and here may be found a résumé of present knowledge of the development

of spores and seeds in the various divisions of the vegetable kingdom, the phenomena of hybridization, of parthenogenesis, and of variation. The closing sentence is, “Evolution is no longer a matter of chance, but is the inevitable outcome of a fundamental property of living matter.”

At the close of each chapter of this most valuable book, copious references to the bibliography of the subjects treated are given ; but, for some reason not apparent, these are only to the works cited, and, except in a few instances, not to pages. Had these been added, it would have greatly facilitated the work of students who desire to pursue the study further. A very extensive index, arranged not only by subjects, but also by authors quoted, is appended.

CHALLENGER REPORTS.

THE Challenger cephalopods were at first placed in the hands of Professor Huxley, whose numerous engagements finally obliged him to decline the work, with the exception of a special investigation into the genus *Spirula*. Mr. William Evans Hoyle, who was intrusted with the work by Mr. John Murray, has devoted the report now under consideration chiefly to systematic work, but expresses his intention of preparing a supplementary article on the anatomy of those specimens which are available for this purpose. He alludes to the fact, that, since the return of the Challenger, marine explorations have been so energetically prosecuted, that no less than five genera, new when obtained by the Challenger, have since been described from the collections of the U. S. steamers Blake and Albatross, etc. Mr. Hoyle has been favored with the assistance and friendly advice of Professor Steenstrup, and has compared with the specimens of the fine collection at Copenhagen all the critical Challenger species, thus insuring a double authenticity for the determinations of the report. The latter commences with an excellent synopsis of the species of recent cephalopods, with references to the places where they are figured and described. The Challenger collection contains seventy-two species of thirty genera. Of these, thirty-two species and four genera were new to science. For one of these, *Amphitritis*, possessing the unique feature of having the mantle fused with the siphon in the median line, so as to form two openings into the branchial cavity, a new family has seemed necessary. None of the giant squids were obtained ; as, indeed, the means for capturing such animals in their native haunts have not yet been devised.

Report of the scientific results of the exploring voyage of the Challenger. Vol. xvi. : Zoölogy. London, Government, 1886. 4°.

those observed or recorded by naturalists being without exception in an invalid condition or cast dead on the shores. With regard to the distribution of the species in depth, there are great difficulties in the way of deciding whether the specimens came from a given depth or not. Circumstances seem to indicate that *Cirroteuthis*, probably *Bathyteuthis* and *Mastigoteuthis*, and perhaps one or two species of *Octopus*, may be reckoned as abyssal forms. But no structural features appear to have been discovered by which a species may be definitely asserted to be a deep or a shallow water animal. This agrees well with the conclusions drawn by others from a study of the deep-sea molluscs of other classes. A full discussion of the geographical distribution of the class gives completeness to the report. In the discussion of genera and species, Mr. Hoyle has the courage of his opinions, and freely criticises where the circumstances seem to him to warrant it, but his tone is uniformly courteous. His report may be heartily commended.

The Stomatopoda are crustaceans related to the common *Squilla* of our southern and eastern coasts, and are restricted to shallow waters. Prof. W. K. Brooks remarks that when he examined the Challenger collection, consisting of only fifteen species, his first feeling was of disappointment, since the types seemed all familiar. But after a more thorough examination, this gave way to a lively interest, since it appeared that the material was such as to enable him to trace the ancestry and development of this small and compact order with great completeness. The Squillidae have a very long larval life, and are found at the surface of the sea, where the currents carry them vast distances; so that some of the species have a nearly world-wide distribution. The larvae are among the most elegant of the immature crustacea found in the tow-net, and naturally excite great interest among the naturalists who capture them. But the young stages do not thrive in confinement, the eggs seem dependent on the parent for suitable conditions up to the time of hatching, and so the connection of the isolated links in the chain of life of any given species has been a task of great difficulty. The very numerous larvae contained in the Challenger collection, and the indefatigable application of Professor Brooks to the problem, have enabled him to add materially to the knowledge of the group, and to smooth away many difficulties for subsequent students. According to the author, the Challenger collections "enable us to determine, with much greater certainty than before, the larval type which pertains to nearly every one of the genera of adult Stomatopoda, and also to give a pretty complete picture

of the developmental history of each larval type."

The collection of reef corals made was a large and important one, there being representatives of two hundred and ninety-three species, referable to sixty-nine genera, and by series large enough in many cases to afford an instructive idea of the very considerable range of variation within a species. Of the whole number, about one-fourth were new. Of the seventy-three new species, seventy-one were obtained in the Pacific, and two in the Atlantic, which illustrates fairly well our comparative knowledge of the two chief coral regions. Of the sixty-nine genera, eight are new, all from the Pacific. The report is confined to a description of the hard parts, the material for anatomical purposes being otherwise disposed of by the authorities. In the generic grouping, Professor Verrill's revised list of Dana's zoophytes, contained in the 'Corals and Coral Islands,' has been followed, with certain amendments as to species. Much use has been made of Professor Moseley's field notes as to the habitat and environment of the corals. A detailed list of the species from each locality has been given, which it is hoped may serve as a basis for a knowledge of the distribution of the reef corals. In classification, Mr. Quelch has mainly followed Duncan for the Madreporaria; but in the Rugosa the occurrence of *Moseleya latistellata* has led the author to apply a new treatment, which he anticipates will lead to some discussion. This remarkable species is directly and closely related to the most typical Cyathophyllidae, while at the same time it presents undeniable astraeid characters. It must be looked upon as one of the most remarkable types of structure brought to light by the Challenger. It occurred at Wednesday Island, Torres Strait, in eight fathoms. The discussion of distribution, areal and bathymetric, is very interesting. The Atlantic reef coral fauna is sharply separated from that of the Pacific and Indian Oceans. The distribution in depth is greater than formerly supposed, two species reaching to seventy fathoms, though it is tolerably certain that the zone of most active growth does not extend much below twenty fathoms. The thermal limit of 68° F., which is doubtless the limit of active reef-building, does not, as formerly was believed, confine the existence of the reef-building species. *Manicina areolata* was obtained at the Cape in water of the temperature of 65°, and *Madrepora borealis* is said to inhabit the cold waters of the White Sea near Archangel, Russia. On this point we confess to some scepticism, until at least a second specimen is obtained; that in the Paris museum, still unique, dating from

1890. Certain corals have been observed living in brackish or even nearly fresh water, others in the mud about the mangrove roots, and one species seemed to suffer little from exposure at low tide to the sun and air. The statement of Edwards and Haime, that a species of coral common in the Red Sea is found in the Dead Sea, is another matter which will bear renewed examination. The report supplements in a satisfactory manner the valuable work of Professor Moseley, and will add materially to the reputation of its author.

This valuable contribution to comparative osteology ('Report on the human crania and other bones of the skeleton,' part ii., by Sir William Turner) is largely devoted to the discussion of the pelvis. The characteristics of the black races differ among themselves as well as from those of the European type, which, as by far the best known, is adopted as a standard of comparison. In most of the negroids the conjugate diameter is long compared with the transverse, and the height increases. In the negroes and Tasmanians these characters are less pronounced compared with Europeans. In nearly all the black races the average length of the sacrum is greater than its average breadth, contrary to what occurs with white races, and, in so much, more like a tail. The lumbar curve in the black races, as derived from the vertebrae alone, is concave forward; the clavicle may be longer in proportion to the humerus than with the whites; the scapular index is apparently higher, except with the Bushmen and Australians, while in the Tasmanian it may have been distinctly lower; the radius and tibia are longer in relation to the humerus and femur; the shaft of the upper limb is proportionally shorter than that of the lower limb. In general, racial characteristics appear in the skeleton as well as in the skull. Among existing races osteological characters may be found similar to those of the most ancient known remains; and the differences which exist between the bones of primitive people are no more, in kind or degree, than are to be seen in corresponding parts of men of the present day.

AGRICULTURE IN MICHIGAN.

THE Michigan board of agriculture is likewise the governing body of the Michigan agricultural college, and considerably more than half of its twenty-fourth report relates to the latter institution. The general report of the secretary is followed by the inaugural address of the new president, Hon. Edwin Willits, and the reports of the

Twenty-fourth annual report of the secretary of the state board of agriculture of the state of Michigan, 1884-85.
Lansing, State, 1886. 8°.

president and professors upon the work of their several departments. This, in most cases, is of a twofold character, — instructional and experimental. Of the instructional work it is hardly necessary to speak, further than to say that it follows the modern methods of teaching the physical sciences, and that, as is well known, ample facilities are provided in the way of laboratories, apparatus, farm, garden, park, etc.

The experimental work of such an institution is necessarily subordinated to the work of instruction; and, while valuable experiments have been made, the college by no means takes the same high rank as an experiment-station that it does as a college. In this connection we note that President Willits, in his inaugural, speaks of the Hatch bill, now pending in congress, as a bill "to make all the agricultural colleges experiment-stations." If this is the intent of the bill, it were better left to slumber in committee of the whole. We certainly shall not look for great good from its passage, if the theory prevails that the professors of an agricultural college can successfully conduct an experiment-station in their leisure moments with an income of fifteen thousand dollars per annum.

AN ingenious gentleman of Evanston, Ill., has succeeded in applying the principle of the injector to a grain-elevator. The grain is run from the car to a revolving hopper, through an aperture in the bottom of which is forced a powerful blast of air, which carries the grain a certain distance up a horizontal tube. At intervals in this tube are bends, or horizontal curves, forming relays. These relays act as auxiliary hoppers, a fresh blast of air being admitted at each one, which carries the grain to the next higher relay. In this way the grain may be raised to any desired height. A modification of this device is arranged to raise grain from the hold of a ship or boat.

— A new method of manufacturing illuminating-gas from crude petroleum consists in conducting a stream of the petroleum to a moderately heated chamber, thereby producing vapor and liquid, and then separately conducting the vapor to decomposing-retorts heated to a certain temperature, and at the same time conducting the liquid portions to decomposing-retorts heated to a higher temperature, whereby the respective products are decomposed, and converted to permanent gas, without overheating either portion.

— An Austrian electrician named Marcus is supplying the German navy with a newly invented petroleum-engine for torpedo-boats. The engine is set in motion by electro-magnetism, and is more powerful than a steam-engine of the same size.

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